Petitions from the colonists in Chalakkudi to transfer the teachers in the colony.

331. മിസ്റ്റർ കെ. പി. വള്ളോൻ.— (a) ചാലക്കുടി കാളനിയിലുള്ള സ്കൂൾ മാസ്റ്റർമാരെ സ്ഥലം മാറ്റണമെന്നു കാളനി നിവാസികൾ അപേക്ഷിച്ചിട്ടുണ്ടോ;

(b) ഉണ്ടെങ്കിൽ അക്കാര്യത്തിൽ എന്തുചെയ്തു?

രാമവർമ്മതമ്പുരാൻ.—(a) കാളനി നിവാസികൾ അപേക്ഷിച്ചിട്ടില്ല.

(b) ഉത്തരം ആവശ്യമില്ല.

Investigations regarding irrigation projects in the State.

332. Mr. T. A. Ramachandra Ayyar.—Will the Government be pleased to place on the table the report of the investigations made by the Public Works Department from the time of Mr. Browning regarding irrigation projects in the State and the amount spent for each investigation?

Mr. M. D. Narayana Ayyar.—The attention of the Member is invited to the answer to question No. 641 of the Legislative Session of 30th Meenam 1104 published on pages 1484, Vol. 2, Part 18 of the printed report.

Reports of further investigations given in the statement appended are placed on the table. (*Appendix XI.*)

An expenditure of Rs. 32,094—9—7 was incurred on these investigations. It is not possible to give the amount in respect of each item separately.

Appointment of an organiser for the Depressed Classes.

333. മിസ്റ്റർ കെ. പി. വള്ളോൻ.—(a) അധഃകൃതരുടെയിടയിൽ സാമുദായിക വേലകളും മറ്റും ചെയ്യാൻ ആർഗനൈസർ എന്നോ മറ്റോ പേരിൽ സി. എം. ചാത്തു എന്നൊരാളെ നിയമിച്ചിട്ടുണ്ടോ; ഉണ്ടെങ്കിൽ ടിയാനുള്ള യോഗ്യതകൾ എന്തെല്ലാം; ടിയാന്റെ ഒരു സ്കൂൾ ഗവമ്മെണ്ടിലേയ്ക്കടുപ്പിക്കാമെന്നു് അധഃകൃത സംരക്ഷകൻ വാഗ്ദാനം ചെയ്തിട്ടുണ്ടോ;

(b) ചാലക്കുടി പോലീസ് ഇൻസ്പെക്ടർ (മിസ്റ്റർ എ. ടി. തോമസ്സ്) പോലീസ് ഇൻസ്പെക്ടരായിരുന്നകാലത്തു് മിസ്റ്റർ എം. ചാത്തുവിനെപ്പറ്റി വല്ല റിപ്പോർട്ടും അയച്ചിട്ടുണ്ടോ; ഉണ്ടെങ്കിൽ അതു ദയവായി മേശപ്പുറത്തുവയ്ക്കുമോ?

രാമവർമ്മതമ്പുരാൻ.—(a) അധഃകൃതരുടെയിടയിൽ സാമുദായികവേലകൾ ചെയ്യാൻ മറ്റാളുമോ അലവൻസൊക്കുടാതെ സി. എം. ചാത്തു എന്ന പടന്നക്കണക്കനെ ഓണറി ഓർഗനൈസറായി നിയമിച്ചിട്ടുണ്ട്. ടിയാനു മലയാളത്തിൽ സാമാന്യം

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tained by the Manager would have shown that my service was purely temporary. To show that increments are not sanctioned to temporary hands, permit me to quote the case of Mr. K. O. Varkey of the very same school to whom increment was refused on a perusal of the service book on the ground that he held no permanent appointment.

4. It would also appear from the endorsement order above referred to that my exemption from undergoing training was due to the fact that my post was temporary. This I beg to submit is not a fact. It was on her own accord that such a recommendation was made, because she might have thought that I had enough service to get a permanent exemption which was subsequently granted by the department on taking my long service into consideration. The fact that it was not because I was a temporary hand that temporary exemption was at first sought for by the Manager will be proved from the fact that one A. N. Kesava Pillai of the same school who was only a temporary male teacher was deputed for training without seeking for any exemption on his behalf.

5. In this connection I may also bring to your kind notice that one Mary D'cunha (a co-petitioner) who was only a temporary hand as per the service book and other records and who had only a service of 6 years to her credit, was ordered to be reinstated, while in spite of my long service of more than 10 years (which itself shows that the term temporary used in my case is meaningless), I do not understand why the same principle cannot be adopted in my case. Dear Sir, it is really painful for me to see that in both cases the plea brought forward is 'Temporary' but one is acquitted and the other is convicted.

6. I belong to a community which is very backward in point of education. Among a population of more than 1,000 I am the only one who have been able to enter at least the aid service and it is only an irony of fate that instead of giving all sorts of encouragement, I am treated in this manner for no fault of mine especially in these days of famine and poverty.

Under the circumstances you may be graciously pleased to order my reinstatement for which I have perfect right and if you deem it otherwise you may—taking into consideration my long service in the school and present critical situation outside—order my reinstatement as a special case for at least three years more or until I get another job whichever may be shorter

Praying for your kind orders at an early date.

APPENDIX XI—(1)

(*Vide Answer to Question No.* 332).

Statement of items of works investigated by the Special Assistant Engineer for Irrigation from 1103—1106.

1. Karuvannur flood prevention scheme in different stages,
2. Manapat chira improvements.
3. Opening a canal from Vettikadavu eastwards.
4. Providing irrigation facilities in Alur village.
5. Improvements to Athur and Elavithingal chiras.
6. Vellarappalli lift Irrigation.
7. Amballur Scheme—bund across the Konath river.
8. The Thanikudam Scheme.
9. The Kurumali Scheme.
10. Opening of a thodu from the Muriyad lake to Kakkathuruthy.

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APPENDIX XI—(2).

PROCEEDINGS OF THE DIWAN OF COCHIN.

Public Works Department.

No. 82.—Read letter dated 18th December 1929, C. No. 49/1105, from the Secretary to the Legislative Council intimating that the following resolution was passed by the Legislative Council in its sitting on Tuesday, the 2nd of Dhanu 1105 (17th December 1929.)

"In view of the great sufferings caused by successive floods from the Manali and Kurumali rivers, this House recommends to the Government to take up at once the scheme of the diversion of water from the Karuvannur river".

(2) The letter dated 10th April 1930, L. C. C. No. 98/1105, from the Chief Engineer, forwarding the following report dealing with the question of flood prevention in the riparian areas near the Kurumali and Karuvannur rivers:—

REGARDING THE DIVERSION OF THE KARUVANNUR RIVER FOR THE PURPOSE OF MINIMISING EFFECTS DUE TO FLOODS.

Floods in general.

1. Lands adjoining the river banks in Cochin have always been subject to inundations by floods of the south-west monsoon. The Periyar, the Chalakkudi, the Karuvannur, the Vadakkancheri and the Bharatha are the principal rivers which traverse the State.

2. The Periyar river floods the whole of Chowwara village to such an extent that the first crop is not generally raised in that village.

3. Floods in the Chalakkudi river affect the paddy lands in Chalakkudi Vynthala and Mala.

4. The Vadakkancheri river, though a comparatively small one, damages the crops in Alur in years of abnormal rainfall.

5. The Bharata river overflows its banks almost every year and complaints have been received of its destructive nature from the villagers of Pallur and Desamangalam.

But from nowhere was the cry so insistent as from the villages of Thottippal and Parappukara which skirts the banks of the Kurumali or the Karuvannur river.

6. Government have not attempted protective works in the case of any of these rivers except the last named. At Pallur or the Bharatha river, however, a productive bund was constructed some years ago by Paliyam, a rich Landlord in the State, but that bund used to be breached now and then and more completely in the floods of 1924.

7. The rivers in the State generally have small bunds along their banks which, while preventing low floods from overtopping them, freely allowed big floods to go over them, thus giving enhanced waterway to drain the excessive run off. Floods therefore never rose very high and did no appreciable damage to crops. In fact, such flooding was even considered to have beneficial effects on lands on account of the large amount of fertilising silt which it deposits on the fields.

8. As times developed, increased communication facilities were given but in some cases road embankments were constructed without adequate openings to discharge the flood waters from rivers. The direct result of these

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road embankments was the inundation of the crops raised in the area which lie between the roads and the river banks. The roads were presumably considered as unchangeable and the question of preventing flooding of the lands was attacked by going against nature and constructing high embankments—high enough to be higher than the highest recorded floods. Embankments such as these have the effect of raising bed level of the river and with it the flood level. The productive works done by the Government on the banks of the Karuvannur are of this nature. The Karupadana and the Triprayar roads where they crossed the paddy fields were raised and strongly protected from erosions but without sufficient waterway to discharge the flood waters which overflows the banks of the Karuvannur river. These roads therefore acted as dams and during floods they caused inundation of the crops in the Arattupuzha and Urakam fields. The affected ryots petitioned to the Government for relief and as a result a very extensive and elaborate flood bank was constructed on the northern side of the river from the Arattupuzha temple for a length of about 3·3 miles to a place called Pottu Chira.

9. Now this bund connects the high ground at Arattupuzha to that at Inchamudi. As a result the waterway for the discharge of the floods has considerably been reduced. The flood level rose consequently and the flooding to the south of the river assumed a graver aspect. Those people then complained in their turn and the Government tried to help them by providing banks on the southern side but not to such a height or as continuous as those on the north. These latter bunds contributed to aggravate matters by further restricting the waterway. At least every alternate year, as a rule, the embanked river finds it impossible to contain the floods within itself and the bunds used to breach in some place or other. The southern bund being lower is breached more frequently causing a good deal of inconvenience and loss to the people. Breaches on a bund, while the river is in high floods, cause much greater destruction to lands due to the high velocity of onrush than if there had been no bund at all and the river overflowed freely and gradually. Even in the years when the bunds did not breach, the flood level was high enough to inundate and destroy some of the Virippu lands in the villages of Thottippal, Parappukkara and Muriyad. High floods in this area have become usual and an event to be naturally expected every year. These villages would then be surrounded by water and communications to them used to be entirely cut off. This caused a good deal of grievance to the people of these villages and they were petitioning the Government for relief. The Government tried to protect them also by again putting up bunds on the Kummali river but it is doubtful whether these bunds stood even one season without breaches.

10. Long lines of bunds require constant supervision and timely closing of all rat-holes all of them can ever be discovered. Even with excellent supervision it is probable that an unusual flood may visit and breach them by overtopping.

So we see how by providing road-ways without sufficient openings, in the first instance, high embankments along the river were necessitated, and in consequence numerous difficulties and problems have arisen which led to the construction of further bunds combating higher floods, and so on from one to the other and all aggravating the conditions which they were designed to alleviate.

The Geography.

11. The Karuvannur river is formed by the junction of the Kurumali and Manali rivers which unite at Palakadavu in the Arattupuzha village, Trichur Taluk. From this point to a distance of about 8 miles, it flows through a

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country which has a gentler slope than the bed of its tributaries, until it reaches a place called Munayam where it divides into two branches:—

One of them which is really the main river goes through Triprayar and meets the sea at Chettuvaye. The other goes through the Connolly canal and empties itself into the backwaters at Karupadanna.

The Kurumali and the Manali rivers are typical hill streams and torrential. They drain an area of about 320 square miles (at the Karuvannur Bridge) and their farthest catchment is not over 24 miles from Karuvannur, the scene of the floods.

Extent of high floods.

12. This catchment area is one which enjoys a heavy precipitation of rainfall which amounts to the high figure of about 140 inches per annum. There were years like 1924 and 1929 when the rainfall was even as high as 209 and 156 inches. This rainfall if fairly well distributed during the year may not cause high floods. But in this case most of it comes down during the months of June and July, in high intensity. August is also a rainy month but heavy rainfalls seldom occur in that month.

13. In considering the question of high flood discharges, the hourly and daily intensities of precipitation have a much greater significance than the yearly rainfall. Records of daily rainfalls for the last 13 years are given in Appendix I. These were taken from Palappalli which are almost the centre of the Kurumali catchment. Records from one place alone may however be considered insufficient for a catchment of 320 square miles. Since this is the only one available, we have to base our calculations on it and in my judgment it may be taken as a fairly reliable record for our guidance. The most important data from those records for the present investigation, are the maximum 24 hour intensities and the frequency with which such intensities occur.

14. The maximum of 24 hour intensities for the last 13 years are tabulated below:—

	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Inches	3·4	4·20	4·70	6·74	5·61 and 7·35	6·65	4·15	9·53	4·22	5·73	3·75	5·20	8·16

*Very unusual reading for August—probably a wrong entry.

15. Of these thirteen years, those of 1924 and 1929, were the years of heaviest flood peaks. The peak intensities were of the order of 9·53" and 8·16". Of the other years, 1920 and 1922 claim to have intensities of the order of 6·74" and 6·65". During the rest of the years the intensities were less than 6" for 24 hours. The heaviest intensity in a certain year it may also be noted, is not usually followed by a figure greater than 3" for 24 hours except of course in the unusual years of 1924 and 1929. In 1924, the exceptional peak of 9·53" was followed by a 4·51", but it suddenly trailed of to 1·93 and 1·38. In 1929, the peak of 8·16 was preceded by a 5·15" and followed by a 6·62". This is a very unusual combination and extremely destructive. The 8·16" fell during the early hours of the 5th of July and by 10 a. m, the bund at Kotleparakkal breached to a length of about 40 feet which

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was widened later. (For details of flood levels for 1929 vide Appendix 4.) The water was rising in the river until 2 in the morning of the 6th when the bunds at Panamkulam higher of the Karuvannur bridge breached to a length of about 80 feet and water was finding its way through several breaches. In spite of these extra passes the level did not fall to that which could be safely contained in the river till the evening of the seventh. The combination of intensities of 1929 in this particular region, it may be seen, was certainly much severer than that of 1924. And the high flood levels corroborate this statement.

16. It is hard to combat nature under these circumstances unless it be by reducing the height of the Karuvannur bunds over its entire length and lowering the Karupadanna and Triprayar roads while at the same time providing in them larger ventways. This course will be objected to by the people on the ground that the Arattupuzha and the Urakam fields will be open to damages every year and therefore cannot be taken up seriously at the present time.

Ignoring therefore the exceptional conditions of 1929 and 1924, the highest intensity can be taken as 6" per 24 hours as a reasonable average for the 320 sq. miles of the catchment. In 1920 and 1922 intensities of 6·74 and 6·65 have occurred. But it is probable that such intensities are not equally distributed over such a large catchment of 320 sq. miles. It is therefore sufficient to base our calculation on a flood due to a rainfall of 6" per 24 hours.

17. We shall now proceed to consider what the capacity of the waterways should be to discharge this flood.

Direct calculation will lead us to the following results—A rainfall of 6" in 24 hours with 60% run off would mean—

$$\frac{60}{100}\times 320\times 5280\times 5280\times\frac{6}{12}\times\frac{1}{24\times 60\times 60}=30976$$

or say, 30,000 cusecs.

Checking this value with Ryve's Formula and taking 675 as the constant, we have the run off as—

$$675\times 320^{\frac{5}{8}}=31530 \text{ cusecs.}$$

Another method by which maximum floods are calculated is by determining the 'critical period' for the catchment and obtaining the value for the maximum hourly intensities of rainfall for the catchment. Taking the extreme end of the catchment in this particular case to 24 miles from the scene of floods and the average velocity of flow to be 4 feet per second, the critical period is 8·8 hours.

A very rare maximum intensity for a catchment with a critical period of 8·8 hours can be taken by equating—

$$I=\frac{240}{8\cdot 8\times 60+30}$$
$$=0\cdot 43" \text{ per hour,}$$

or at the rate of 53,278 cusecs with a 60% run off.

18. Apart from figures of 'rare' intensities we have those of which may be styled as 'remarkable'. Such values do not usually occur oftener than once in ten years. Such a value of intensity is got by equating—

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$$I = \frac{168}{8{\cdot}8 - 60 + 30}$$

$$= 0{\cdot}29'' \text{ per hour,}$$

and at 60% run off for the catchment the rate of flow is 36,000 cusecs.

The entire discharge from the catchment has to pass under the bridge at Karuvannur. This is a structure with 230 feet clear ventway. The velocity was measured at the site and was found to be approximately 3 feet per second during high floods. Detailed calculations for arriving at the discharge through the bridge is given in Appendix 2.

The results are however tabulated below:—

Depth of water at bridge.		*Discharge in Cusecs.*
12'	..	10,000
13'	..	11,800
14'	..	14,000
15'	..	17,000

Discharges over 15' depth are not given, as, if the river rises to 16', high flood conditions become established and bunds will breach somewhere.

Cross sections of the river below the bridge are shown in plan No. 5.

The discharge characteristics of these cross sections when there was 14·5 feet of water at the bridge is given in Appendix 17. Bazin's formula is operated for calculating discharges. Accurate surface fall readings are taken for determining 'S', vide Appendix 16, for gauge readings of the river during floods. Position of the gauges is shown in plan No. 3. This will show that the channel is capable of discharging about 20,000 cusecs when the river is 14.5 feet high at the bridge.

19. We have found that the discharge on rare occasions is as high as 53,278 cusecs and fairly frequently it is 36,000 cusecs. The bridge being capable of only passing 17,000 cusecs at its maximum depth of 15 feet, the reason for floods and breaches becomes clear. The river channel itself cannot take anything much higher than about 20,000 cusecs. Additional waterway therefore appears to be the only solution.

20. Now the following questions arise—

(1) What the capacity of the additional waterway should be;

(2) What is the cheapest method of providing this waterway and what will be its cost; and

(3) Whether the cost is justified by the protection it will afford?

The river can be fed with 20,000 cusecs if the channel to the new bridge at Karuvannur is improved.

Capacity of additional ventway.

This would directly take us to the figure of 16,000 (36,000—20,00.) cusecs for the capacity of the new channels. Artificial diversion of this large quantity would have been necessary had it not been for the fact that an extensive area of low lying lands known as the Muriyad lake is situated direct-by above the bridge. The river water can flood this area without harm as it will not be under cultivation during the months of June, July and August. The area of this lake is 8·4 sq. miles and I propose to figure on its equalising effects on the floods in my calculations.

If that be so done, the maximum daily run off from the catchment is the figure to be taken in our discussion instead of the maximum run off at any particular time.

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I have already stated my reasons for taking the run off figure on the basis of a 6" rainfall per day. This would as worked out above be equivalent to a steady discharge of 30,000 cusecs for a day.

Suppose that at the beginning of a flood in the river, the reading at the bridge is 12'—0" and it steadily goes up to 15 feet in 24 hours.

Then the average discharge through the bridge is—

$$1/3 \left\{ \frac{10,000}{2} + 11,800 + 14,000 + \frac{17,000}{2} \right\} = 13,100$$

or say, 13,000 cusecs.

The water spread of the Muriyad lake (8·4 sq. miles) is taken as constant for the gauge readings from 12 to 15. This assumption will err only on the safe side.

Discharge into the lake—

$$\frac{8{\cdot}4 \times 5280 \times 5280 \times 3}{24 \times 60 \times 60} = 8131$$

or say 8,000 cusecs.

21. If improvements are effected to the thodu leading to the new bridge at Karunnur the average discharge through this may be taken as 2,000 cusecs. Balance quantity to be disposed of is therefore 7,000 cusecs.

22. Works necessary to deal with this quantity of 7,000 cusecs are given below:—

A channel of 4000 cusecs capacity connecting the Muriyad lake with the Moorkanad Kayal.—The Karupadanna road divides the two extensive areas of Puncha or low levl lands known as the Muriyad and Moorkanad lakes. Between them the road runs on a ridge of laterite high ground. At 10/4 of the road the distance between the lakes is comparatively small and it is proposed to cut a channel with a 40 feet bottom width at this place. The discharge calculations are given in Appendix 6.

This will lead the water to the Moorkanad Kayal through which it will flow and empty back into the river at a place known as Nandhi. The major portion of the Moorkanad Kayal is under Puncha cultivation and there should not be any damage to the lands there due to this diversion. Skirting the kayal on the high portions, however. Virippu is cultivated to an extent of about 338 acres, vide Appendix 5. The kayal being a very wide one, the rise in level due to the passage of 4,000 cusecs is not expected to be of an order which will cause on this account any damage to these crops. An embankment is now being made at Karlom connecting it with Kizhuthani. This water has to pass under a bridge of this embankment. Its span is 120' at top but it is constructed in such a manner as to enable its being widened if found necessary.

Extra works will have to be done to lead this quantity of water to the Enamakkal lake. These works are:—

(1) *Improvements to the Chirakkal Thodu.*—The old bridge across this canal gave way in the year 1926 and it was reconstructed with an increased span of 50'. But the canal is not 50' wide in many places. This has therefore been proposed to be widened and properly graded.

(2) Another canal may be cut from the river to the east of the Chirakkal Thodu with a bottom width of 50' capable of discharging 3,000 cusecs into the Enamakkal lake. The alignment of this canal is marked in plan No. 2.

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(3) *Widening of Pazhool Bridge.*—This bridge has at present a span of 33 feet. It may be rebuilt with a span of 70' and the canal suitably aligned and widened.

23. *The Marathakkara diversion*—The proposal is to cut a canal from the Manali river past Padavarat hill and to lead it to the kole lands at Kanimangalam. Capacity of the canal is to be 1,500 cusecs.

The Kakkathuruthi Canal.—Estimates for this work have already been submitted. The capacity of the canal is to be 500 cusecs. The above mentioned works account for 6,000 out of the 7,000 cusecs to be disposed of.

If even after the above works are completed, additional waterway be found absolutely necessary, the Moorkanad kayal canal and the Marathakkara canal may be widened so that they may take in an extra 1,000 cusecs.

24. It is always safer whlle doing such flood diversions to proceed cautiously, step by step, so that no preventible damage or loss does happen either to the people or to the Government. I therefore recommend the execution of the works detailed above in the following stage:—

			Rs.
Stage 1.	1.	Constructing the Moorkanad canal with a bottom width of 17'—6" and a capacity of 1,500 cusecs. A bridge of 50' span across Karupadana road at 10/4 will also be necessary. Cost	45,000
	2.	Improvement to Chirakkal Thodu	8,000
	3.	Improving a canal to the new bridge at Karuvannur	8,600
Stage 2.	1.	Widening the Moorkanad canal to increase its capacity to 2,500 cusecs.	6,000
	2.	Improvements to Pazhool Thodu and reconstructing bridge with larger ventway.	50,000
Stage 3.	1.	Opening of a canal to the east of the Chirakkal bridge with a bottom width of 50'.	62,000
	2.	Widening the Moorkanad canal to its designed capacity of 4,000 cusecs.	9,000
Stage 4.		Marathakkara diversion of the Manali river.	97,000

25. The details for the cost reports for all the works listed above are given in the Appendices Nos. 9 to 15.

26. The works detailed in stages 1, 2 and 3 cost Rs. 1,88,600 and will deal with 6,000 cusecs of water.

The stage 4 costs 97,000 and deals with 1,500 cusecs.

The cost of Kakkathuruthi diversion need not be taken into consideration here as it is mostly meant for navigation facilities for Irinjalakkuda.

The total cost of the proposed works therefore comes to Rs. 2,85,600.

27. We may now consider the benefits which will be derived from the works. They are principally—

(1) Freedom from frequent breaches of the Karvannur bund. The cost of repairing breaches during the last ten years is Rs. 42,839 distributed as follows;—

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Years.		Amounts. Rs.	A.	P.
1095	..	11,534	8	11
1096	..	9,910	10	9
1097	..	5,341	10	5
1098	..	3,283	5	7
1099	...	..		
1100	..	8,193	0	1
1101	..	163	14	1
1102	...	2,040	6	3
1103	..	276	14	2
1104	..	2,094	9	8
		42,838	15	11 or Rs. 42,839

(2) Extent of Virippu crops which will be saved from the floods is given below.—

			acres
1	Neymanikkara	..	400 ,,
2	Thrava	..	150 ,,
3	Nellayi	..	100 ,,
4	Chengallur	..	30 ,,
5	Parappukkara	..	120 ,,
6	Thottippal	..	30 ,,
7	Anmthapuram	...	50 ,,
8	Muriyad	...	30 ,,
			910 acres.

(But how far were the floods detrimental to the crops is a matter which requires further examination. I was not able to get any reliable information. The paddy crop is a hardy one and is not likely to be affected greately by inundation for three or four days. But if such inundation occurs when they flower it may prove destructive).

(3) It will in any case to a considerable extent relieve the ryots from uncertainty and the consequent worries of cultivation.

28. A word has to be said about the inadvisability of taking up the Pallisseri diversion which was also investigated in this connection. This consists of constructing a canal from the Karuvannur river at Kottikkal and taking it through valuable double crop lands on the northern side of the Arattupuzha and Urakam fields and leading it to the kole lands at Pampatty on the Triprayar road.

The disadvantages of this proposal are—

(1) The level of water in the canal during high floods will be higher than the Virippu lands adjoining. A breach on the canal banks will prove destructive to crops. A flood like that of 1929 would have caused considerable damage to lands, and the work, if it had been completed before the 1929 monsoon would have been seriously injured.

(2) The lands through which the canal passes do not permit of a good bed slop being given. The bed fall could not have been more than one foot per mile. The river is much silt laden and it is highly probable that considerable silting would occur in the canal. This will decrease the discharging capacity and increase the liability to breaches.

(3) This canal which can discharge only 1,500 cusecs will cost nearly Rs. 1,45,000. Compare this with a discharge of 6,000 cusecs for 1,88,600

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for the works now proposed. The cost of the work therefore, is not in proportion to its utility.

I solicit early Government orders on my recommendations contained in paras 24 and 25 of this report.

I wish to acknowledge the help rendered to me by the Special Assistant Engineer for Irrigation, Mr. A. George and his staff in regard to the several investigations conducted in connection with this scheme.

APPENDIX XI—(3).

Letter dated 25th March 1930, R. O. C. No. 1236/04, from the Chief Engineer.

"With reference to official memorandum dated February 19, 1930, C. No. 478/1105, I have the honour to report the following:—

The proposal for the improvements to the Manapat chira consists of:

(1) Reconstructing the two sluices,
(2) Realigning the Irrigation channels,
(3) Providing a surplus arrangement with a surplus channel,
(4) Raising and strengthening the bund, and
(5) Acquiring lands inside the chira.

Of these, the first three items are absolutely necessary and they have to be attended to in any case without much delay. The cost of these items amounts to Rs. 25,300 according to the estimate. If the bund is not to be raised the cost may become slightly less since the height of the sluices can be reduced. Thus an amount of about Rs. 20 to 25 thousand will have to be spent for keeping the chira in good working order. If these works alone are done there will not be any appreciable increase in the revenue and hence there can be no return for the amount invested. These alone are merely protective. It was on this account that the raising of the chira was proposed. While affording protection the execution of the other works will give an increased return on the amount invested. The cost of raising the bund and strengthening the same will come to only Rs. 12,556 according to the original estimate. The total cost of the scheme including land acquisition charges inside the chira and supervision was estimated at Rs. 45,100. If this amount is invested an increased revenue of at least Rs. 1,622 or three per cent on the amount spent is expected to be derived as water-cess.

The Diwan Peishkar is of opinion that the lands inside the chira need not be acquired. In scuh a case the acquisition charges may be eliminated from the estimate and Rs. 3,000 provided in it for a third sluice proposed by him. If as proposed the Puncha lands inside the chira are not to be acquired, no water can be stored in the chira for cultivation of Puncha lands outside. It was calculated that about 3½ feet of water would be left in the chira above the proposed sill level after the Mundakan season which might be used for cultivation of Puncha lands outside the chira. This water may not be of use if the lands inside the chira are not to be acquired. In this case, the bund also need not be raised to the same height as originally proposed. From the statement of storage capacity of the Manapat chira it may be seen that the bund need be now raised only to about plus 82·0 instead of plus 84·0. If it is afterwards found that it is more advantageous to have the lands inside the chira also acquired, the bund may be raised by this height, viz., 2 feet. The estimate has been corrected accordingly and it now amounts to Rs. 41,000.

The Superintendent of Agriculture and Panchayats estimates that there will be about 6 million c. ft. of water between the levels plus 66·0 and plus

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70 0 and that it will take a week to drain it away completely. The capacity of the chira between the above levels as worked out is 3,125,250 c. ft. or nearly 3 million c. ft. only. If the sluice is only 2 ft. by 2 ft. in section the chira water could be emptied in less than 3 days, and if it be 3 ft, by 2 ft. it could be done in less than 2 days (Please see separate calculation attached). It is not therefore a very serious matter to deal with this water. The rate of acquisition charges as mentioned in the report of the Superintendent of Agriculture and Panchayats appears to be very high considering the fact that the owners have, as I am given to understand, not complete claim over the lands which are therefore classified only as virippu lands of the 6th and 7th tharam. The Superintendent has referred to his report dated 3rd Dhanu 1105 on which he says that he recommended for certain works to be done there. When copy of his above report was called for he has furnished a copy of his report, dated 9th Kanni 1104 C. No. 977/1099. In this he has suggested certain works costing about Rs. 12,000. There is nothing mentioned by him as to what he proposes to do with the present damaged sluices. The bed level of the off-take channel is to be raised by 5 ft. Sufficient amount is not seen set apart for opening new channels if the beds are to be raised. The cost of Rs. 1,000 probably meant for surplus arrangement by him is not sufficient, if a surplus channel has also to be opened from the same. About the Inchakundu diversion, the Superintendent was already informed in person by the Special Assistant Engineer at site about the impracticability of it on account of the difference in levels noted.

The special investigation ordered and taken up is for a comprehensive scheme touching all points and these have, it may be said, been carefully looked into in the investigation.

The estimate corrected is herewith resubmitted for approval and early sanction."

(True copy)

APPENDIX XI.—(4)

Report to accompany the estimate for opening a thodu from Vettikadavu eastwards.

The Vettikadavu thodu is the main drainage channel for the villages of Mangad on the north, Porkolam on the east and Kunnamkulam on the south, and it takes its water into the sea through Viyyathukettu. During the monsoons, the wet lands of the neighbouring villages are usually inundated. Of these, the lands lying between Vettikadavu and Viyyathukettu are now cultivated with Puncha crops during the period between March and May. But the lands about 250 acres in extent lying to the east of Vettikadavu are at a slightly high level and hence Mundakan cultivation is generally done on the major portion of these lands. Since the Mundakan cultivation has been found to be hazardous ryots have begun to try Kuttadan crop which also does not appear to be successful in the area. About 85 acres of these lands are now successfully cultivated with an early Puncha crop and there are facilities provided for the same in this area. This area is coloured blue in the site plan. The land owners of the remaining area desire to have similar facilities provided in their area also so that they may raise Puncha crop on their Mundakan lands. The special party conducted the investigation and reported on the scheme.

An estimate amounting to Rs. 3,000 is prepared for opening a thodu from Vettikadavu. The alignment of the proposed channel is marked in red

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ink in the site plan. It is taken almost along the middle of the area affected so as to give easy irrigation facilities on both sides. The longitudinal section is submitted. The spot levels of the fields are shown in burnt sienna in the key map. The length of the channel now proposed to be opened is about a mile and the width varies from ten feet at the off-take to seven feet at the tail end. This may be extended if it is afterwards found that there is enough water for the extension. The approximate area that may be commanded by this channel is marked red in the site plan, and its extent is about 15 acres in Mangad, 50 acres in Porkolam and 45 acres in Kunnamkulam villages. No provision is made for field distributaries, which may be left to be done by the ryots at their own cost.

A sum of Rs. 1,835 is provided in the estimate for land acquisition including eviction charges. Land plans and schedule are submitted. No return can be expected for this small expenditure. The lands will be improved and additional tax can be expected in the next settlement.

(True copy)

APPENDIX XI—(5).

Specification to accompany the estimate for providing irrigation facilities in the Alur village of the Talappalli Taluk.

The amount of estimate is Rs. 2,100.

The estimate provides for regrading a portion of the existing channel starting from Peruvanchira and opening new channel wherever necessary so that the excess water of Peruvanchira may be diverted to the fields lying in the village. This water is carried across the river through a trough work which is supported on R. C. trestles and which may be removed before the floods.

A provision of Rs. 390 is made for land acquisition charges.

The work is to be carried out in conformity with the rules laid down in the standard specification of the department and to the satisfaction of the Chief Engineer and his deputies.

(True copy)

APPENDIX XI—(6).

Letter dated 17th October 1929, C. No. 1113/1104, from the Chief Engineer.

Subject:—Improvements to Athur chira.

Ref:—Diwan's proceedings, dated December 6, 1928, C. No. 576 of 1104.

"1. The Athur and Elavathingal chiras and the lands served by them were inspected by the Superintendent of Agriculture and Panchayats and myself on October 16, 1929. During the late floods, the Athur chira has been very badly damaged. Some of the beams used for inserting the shutter planks were washed away and portions of masonry in abutments and piers were also washed off. It is not possible to effect any repairs. The whole chira requires reconstruction with coursed rubble in combination mortar.

2. The ventway of the present chira also appears inadequate. The length of ventway of the main chira with its two vents is 39' 0". There is also a surplus sluice about 45' long. But this surplus sluice has its silt much higher than the bed of the river and so it will begin to be effective only

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when water in the river rises very high. The ventway of the Vadakkancheri bridge which is over the same river is 54' 0". I therefore think that in rebuilding the chira, an increased ventway may be provided. A chira with three vents each 18' 0" will be enough. This will cost about Rs. 8,000.

3. The surplus sluice also requires some attention, such as repairs to floor, provision of shutter planks, etc. The provision of shutter planks for the surplus sluice will increase the storage capacity of the chira and this can be done with perfect safety, as the ventway of the main chira is proposed to be increased to 54' in para 2 above. The works proposed for the surplus sluice will cost about Rs. 1,000.

4. At present the water of the irrigation canal taking off the river above the Athur chira is simply wasted as it flows back into the river at the point marked M in the sketch herewith submitted. The Elavathingal chira is near by this point and when rains hold off for a few days, there is scarcity of water in this canal. If therefore a canal is opened to connect the Athur irrigation canal with this Elavathingal canal, the water that is now going to waste may be diverted to the Elavathingal canal to relieve scarcity there. This canal may be cut somewhere on the site marked AB. This will be about 1,000 feet long and may cost about Rs. 2,000 inclusive of land acquisition charges. The exact location of this canal may be fixed after investigation. A regulating sluice will be necessary at the place marked 'E' a little below the offtake of this canal. This will cost about Rs. 1,000.

The Tahsildar in para 5 of his report, dated 27th Thulam 1104, recommends that the supply channel marked CD under the Elavathingal chira may be silt cleared and deepened at a cost of about Rs. 1,000. This is very necessary, but I doubt whether it is the business of the Government to improve field supply channels. The interested ryots may well be left to attend to this.

5. The Elavathingal chira also requires slight repairs, such as replacing damaged shutter planks, grouting and pointing the floor, etc. This will cost Rs. 300.

The above proposals have been framed in consultation with the Superintendent of Agriculture and Panchayats. The total cost comes to Rs. 12,300. It may be provided in the budget for 1106.

The enclosure mentioned in para 3 of the above Proceedings is returned."

(True copy)

APPENDIX XI (7).

Report to accompany the estimate for the Vellarapilly lift Irrigation Scheme.

"The Scheme consists of pumping up water from the Periyar river at a place near the Kanjur church and leading the water in suitable channels to the fields lying in the Vadakkumbhagam and Chowwara villages. The total extent of wet lands in these villages is approximately 2200 acres of which about 2000 acres are single crop lands. Scarcity of water is felt during the Mundakan season, and if a supply is assured second crop can be cultivated with success. The Periyar river overflows its banks during the south-west monsoons in some years, and the silt carried by the river is deposited in fields making them very fertile. The great flood of 1099 has brought in a large accumulation of alluvial soil into the lands and the fertility of the soil has been greatly increased. But the soil is rendered not quite productive

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on account of the absence of irrigation facilities during the Mundakan season. It may be mentioned here that owing to the proximity of the Periyar river and the Chengal thodu the subsoil water is easily drained away and the soil rendered dry.

The level of water in the Periyar river during the Mundakan season at the site proposed is far below the field level and hence water has to be mechanically lifted so as to effect irrigation facilities to the lands. The Mechanical Assistant is engaged in the erection of the pumping plant, etc., and the Special Assistant Engineer in the design of the channels.

The site first selected was at the confluence of the Chengal thodu with the main river. This has the advantage that it is very near to the wet lands and hence the length of cutting to the wet lands will be little. But it was found afterwards that at this place there may not be enough water near the bank during summer when water may have to be pumped for Puncha cultivation. The site was therefore changed to a little south where the Thalipara stream joins the river. It is understood that there will be enough water near the bank at this altered site throughout the year.

It is proposed to utilise here some of the dismantled machinery lying at Chowwara Head Works. It consists of a 45 B. H. P. Blackstone Cold Starting Engine, one 10" low lift Centrifugal Pump, and one 2 ft. x 7" Turbine Pump. The 10" low lift pump will discharge about 60,000 to 80,000 gallons per hour and the other about 35,000 to 40,000 gallons. The total discharge from both the pumps will be about 1,00,000 to 1,20,000 gallons per hour. This is equivalent to about 5 cusecs. The engine will drive a 4" countershaft which will in turn drive both the pumps.

The latter discharges into a common rising main and empties into the masonry basin provided at the head of the channel.

The levels taken with an assumed datum are shown in the site plan in burut sienna and the alignment of the channel in red ink The original idea was to have the bed level of the channel at the starting point at plus 34·00. Since the old pumps are not capable of discharging the required quantity of water especially during the Puncha season against this head the bed level is reduced to plus 32·00.

The main channel proposed to be done this year is shown in the plan. It is taken in such a way as to give water to the lands that suffer badly for want of it. The extent that can be commanded is roughly 500 acres and they are mostly single crop virippu lands. They may be converted into double crop lands.

The next alignment may be more or less along the Chowwara-Malayattur road and then along the borders of parambas round Kaipara Kunnu.

The bottom width of the channel is 5 feet for a length of 7734 feet and 4 feet up to 12752 and 3 feet in the tail end. The total length is about 2¾ miles. The gradient proposed is 1 foot per mile and the capacity of the first reach of the channel with 2 feet depth of water is 7½ cusecs as worked out in the appendix. The longitudinal section of the channel is herein enclosed. There are two culverts proposed each of 6 feet span, one of the Chowwara-Malayattur road and the other on the road leading to Kanjur bazaar.

Land plans and schedule for acquisition are already forwarded for necessary action.

The amount of estimate prepared by the special Assistant Engineer for the channels, etc., is Rs. 7,300 and that prepared by the Mechanical Assistant for the erection of machinery, etc., is Rs. 4,000. The latter estimate does not include the cost of machinery.

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It is expected that an amount of Rs. 800 may be obtained as additional revenue. The exact amount has to be ascertained from the Revenue Department. The maintenance charges for the channels including petty supervision may be about Rs. 200. This does not include the charges on the Mechanical side."

(True copy)

APPENDIX XI—(8).

Report to accompany estimate for a Bund across the Konath river to prevent access of brackish water to lands in Cochin and Travancore.

The Konath river is the continuation of the drainage course commencing from Vettuveli on the Mamala river and runniug southwards. On this line are the bunds known as the Vettuveli chira, Karingo chira and Kaniavalli chira. The drainage line empties itself by the Poothotta gap into the main backwater. Between the backwater and the river valley there is a long narrow sandspit extending from Trippunittura to Poothotta gap. The bunds mentioned above protect the paddy lands lying on both sides of the river from access of brackish water and irrigate them. On the major portion of this area two goodcrops are grown in the year. On the rest only one crop is obtained. Below the lowest bund *viz.*, the Kaniavalli chira the lands are unprotected. The mid-stream of the Konath river here forms the boundary between Travancore and Cochin and lands in both States suffer from the access of brackishwater. For some time past ryots in both States have been asking for protective works and consultations have taken place between our P. W. D. and the Travancore P. W. D.

2. The lands affected are what are known as 'Kari' lands lying at or slightly above mean sea-level. The sowing is done in May—June on small earth-mounds called 'Kannies' which keeps the plants high above access of brackish water and prevent submergence during early monsoon freshes. When the water becomes sweet and the plants are grown high enough to withstand small freshes, they are taken up by spades and distributed broadcast on the fields. The harvest is gathered in August—September before the water becomesbrackish again after the cessation of the south-west monsoon. A second crop is practically out of the question. The difficulty of cultivating even the one crop is that if the first monsoon rains and freshes are late, the sowing is unduly delayed and if the monsoon ceases early and the brackishness reappears before the paddy is ripe, the harvest is damaged. A bund across the river preventing access of brackishness will enable the crops being sown earlier and protect the harvest from brackishness re-appearing after the cessation of the monsoon. The bund will also store sweet water for irrigating the crop. After some time if the works now proposed are found effective and unobjectionable otherwise even two crops may be raised on these lands as is now done under the higher bunds.

3. The two obvious objections to the bund are (i) the stoppage of navigation and (ii) the obstruction to drainage of freshes.

(i) As the north end of the Konath river is blind by reason of the Kaniavalli chira, the navigation is not very important. To provide for it will necessitate the erection of a lock in the proposed bund which, however, cheaply made, cannot be justified by the amount of present traffic. It must also be noted that there is a parallel line of navigation in the back-water within half a mile of the Konath river. If at any time in the future a lock is found necessary it can be added provided the expenditure can be justified

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by the traffic. This is very unlikely. No provision is, therefore, made in the present estimate for navigation across the bund.*

(ii) The Travancore Engineers laid stress on the second objection, *viz.*, drainage. They said a new cut across the land spit to the backwater is necessary. Provision is, however, made in the present estimate for a gap of 60 feet bottom width in the bund and situated near to but not on the main bund across the river. The sill of this gap is 2½ feet below low water. The opening is intended to be bunded up periodically in dry weather when there is danger of access of brackishness and opened as necessary whenever water is high on the upper side of the bund. The arrangement consists of 12 six foot bays with re-inforced concrete posts in two rows 4 feet apart. Against the R. C. posts cheap mango planks can be laid horizontally and the intervening space of four feet may be filled with clay or other impervious soil. As many bays of this may be opened as may be necessary, or all of them, in the monsoon season and all the bays may be closed when brackishness appears below the bund. This method of working has been successfully demonstrated at Enammakkal bund which protects from brackishness 15,000 acres of land, situated partly in Cochin and partly in British territory. The cost is shared by the Madras Government and the Cochin State. With further experience one or two bays at one or both ends of the gap may be provided with screw gearing or other easily opened shutters so that small freshes may be passed and the openings closed without repeated breaching of the bays and re-making of the temporary bunds in the drainage gap, Such shutters are, however, not provided in this etimate. They may be put in if experience dictates their necessity. If it is found that the drainage cannot be dealt with even thus, then the cut across the spit proposed by the Travancore Engineer may be made. It does not, however, seem necessary to anticipate such a contingency and make that drainage cut initially.

4. For locating the bund a site was proposed by the Travancore Engineers somewhat high up at a place called Mattathankadavu (see key map). At this site the soil and sub-soil are firmer and the length of the bund is much less than at the site now proposed. The bund will thus be cheaper. But such a location will leave a large piece of 600 acres of Cochin lands unprotected. As it is suggested below that the cost of the proposed bund should be borne proportionately to the areas of land protected in either State, any increase in the cost of the bund as now proposed will be practically borne by Cochin and so there should be no objection from Travancore to this location. The actual location is along the north or right bank of the Vallithara thodu which is the upper of two cross drainages falling into the Konath river on its left (or Cochin) side near Poothotta gap. With this location the area of lands protected will be 873 acres in Cochin and 866 acres in Travancore. The areas are thus nearly equal.

5. The bund will consist of three parts, *viz.*, (i) The main bund in the river;

(ii) A short extension to the west in Travancore territory to meet high ground; and

(iii) A long extension on the east bank along the southern boundary of the broad extent of paddy lands in Cochin territory.

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* Navigation of small boats in the season when the bund is open, as is possible at the Kaniavalli chira and in the bund proposed by the Travancore Chief Engineer is possible across the bund proposed in this estimate also.

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In this eastern extension and near the main bund will be situated the drainage gap of 60 feet bottom width with provision for making and remaking of the temporary bund. The height of the main bund and the extension in Travancore territory and the portion of the extension in Cochin up to and a little beyond the drainage gap will be kept at R. L. 105·00 which is higher than the flood level of 1099, the highest on record. It is undesirable that the bund should be overtopped in this portion even in such an extraordinary flood. The rest of the extension in Cochin territory is made with its top at R. L. 101·00, *i. e*, well above any ordinary flood. As an additional precaution a length of 150 feet of the extension bund is kept at R. L. 101·50 so as to locate any possible breach due to overtopping to this place where it can easily be mended.

6. When the temporary bunds on the drainage gap are intact (*i. e*, for 8 or 9 months, say from August—September to May—June) the bund and extensions will form a foot-path for pedestrians from high ground in Cochin to high ground in Travancore. If later on screw gearing shutters are provided for some of the bays in the drainage gap, it may be desirable to provide a light foot-bridge across the gap for working the shutters and this will make the foot-path feasible at all seasons.

7. The estimate of the works now proposed comes to Rs. 18,170. The maintenance of the bund including the cost of opening and re-making the bays of the drainage gap is estimated at Rs. 500 per annum. I would recommend that the whole of the work, including the portion of the bund in Travancore territory should be made and maintained by us and the actual capital cost and the annual maintenance charges be borne equally by the two States. The land for the bund in Travancore should be acquired and placed at our disposal by that State.

8. If improvements to the bund such as have been suggested above, *viz*., screw gearing shutters for some bays in the drainage gap, a foot-bridge or a lock, or any other necessary, such works should be estimated by us and carried out after approval has been secured from Travancore. The actual cost should be borne equally by the two States.

9. On the other hand if it is found that the drainage cut across the sand-spit in Travancore territory be necessary, the work should be estimated by the Travancore P. W. D. and after our approval, carried out by the Travancore State and we should contribute half the cost including land compensation and supervision.

10. The cost of the works now estimated for works out to Rs. 10·4 per acre. It is an expenditure that the ryots may reasonably expect the Government to bear. I do not suggest that any cess should be levied to meet the interest charges on this outlay. If, however, these works and any improvements found necessary by subsequent experience enable a second crop to be raised on any part of the ayacut, Government will under the present Revenue Rules, be entitled to levy a cess equal to one-fourth of the tax for lands so cultivated.

11. Before concluding, I must mention that practically all the work involved in submitting this estimate had been finished before I took charge I had merely to put a few finishing touches on the designs and write this report the materials for which had been got ready. I wish also to add that great credit is due to Special Assistant Engineer Mr. A. George for the commendable way in which he did the field work and the designing which has enabled me to place this cheap and feasible scheme before Government. I hope it will be welcomed by the authorities and people of Travancore also.

(True copy)

(Signed)
Ag. Chief Engineer

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APPENDIX [XI—(9).
THANIKUDAM PROJECT.

Sources of Data.—

In the Diwan's Proceedings dated 22nd November 1925, Dis. No. 379/D/1101, the Chief Engineer was ordered to take necessary steps for investigating the Thanikudam valley for water storage purposes. Accordingly a field staff consisting of the P. W. D. Surveyor, a temporary surveyor and six lascars was constituted with orders to conduct a preliminary compass survey of the area with contours at every 5 feet vertical intervals up to an elevation level of 130 feet of the G. T. S. levels. This contemplated a height of Dam of about 44 feet at a site shown in the contour plan accompanying this report. All levels indicated in the plan are connected with the G. T. S. levels.

The information given in this report regarding the capacity of the proposed reservoir at different levels with the flooded area of the same at those levels is based upon the survey conducted by the above party. The accuracy of the details furnished was checked often in the field and was found to be as satisfactory as could be expected from a compass survey.

Direct stream flow readings were not available for the monsoon months. The yield of the catchment is computed from the average of the rainfall records maintained in the neighbouring localities.

Summary of Report.—

The proposals for constructing a masonry dam of about 75 feet high across the stream at Naduthodu which will impound water during the monsoon months from June to November, for making it available for Kole cultivation in the Trichur Taluk during the months of February and March. The investigation shows that the reservoir would be unable to irrigate lands which are not at present commanded by the river if it is required to supply water to the Kole lands. Hence it was not considered necessary to take into account fresh supply channels the present river itself being utilised as the supply channel.

General Introductory.—

The proposed Thanikudam Basin is situated at about 6½ miles north-east of the town of Trichur.

The Thanikudam river takes its source from the Vellani Hills and flowing in a south-westerly direction empties itself into the Kole lands. This is a hill stream, torrential in nature during the monsoon but running dry soon after it, its discharge being no more than a trickle from the 15th of January.

The drainage area, as computed from the Government of India maps; is about 11½ sq. miles. This is at present mostly covered up with jungle growth except for a small portion of about 200 acres of low land which is being cultivated. The geological conditions indicate that the drainage area is composed of light sand and clay overlying a bed of soft laterite for a depth ranging between 0 to 38 feet. A stratum of hard gneiss of unknown depth is found below the laterite.

Water Supply.—

(1) General description of Drainage Area :—

The character of the catchment area is such that the run off is rapid. It does not absorb water to any appreciable extent. Sudden floods in the river happen therefore and for the same reason the river runs dry soon after the seasonal rains. The character of the basin is one which will be impervious to percolation of water from high heads resulting from storage. Even if slight leakages from the reservoir should be evidenced during the beginning

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of storage, it will, in my opinion, be reduced considerably within a few years as the fine silt from the river cements the tiny percolation paths in the sub-soil.

Run-off Records.—

No information was available of the run-off records of the stream. The flow for the 3 months following the monsoon was taken and the calculated discharge given in Appendix I.

It is desirable to cause the run-off records for a few years at least to be taken for gauging the yearly discharge from the catchment.

The maximum discharge from the catchments as arrived at by calculations from observations of high water marks comes to about 6,000 cusecs. This checks fairly well with the discharge calculated from Ryve's formula, assuming the co-efficient to be 1,200 in

$Q = C \times M\ 2/3$ where

Q=The maximum discharge in cusecs

C=Co-efficient

M=Extension in sq. miles of catchment.

In this particular case, the formula after substitution becomes:

$Q = 1{,}200 \times 11{\cdot}5\ 2/3 = 6{,}114$ cusecs.

Rainfall Evaporation.—

There were no records of rainfall in the catchment area. But readings from the adjacent areas of Trichur and Vadakkancheri were available. These are tabulated in Appendix ii, with an average monthly rainfall computed from the original readings.

This latter shows that the lowest recorded yearly rainfall for 8 years is 91·41 inches.

Evaporation losses are negligible and may be ignored. Accurate observations showed that the maximum evaporation loss during the hot months with heavy land breeze was only about 5/16 of an inch per day of 24 hours.

Existing Developments in the Bed.—

Except for a small diversion weir at a place called Kallai about 2 miles below the site of the proposed dam, there are no irrigation works of any magnitude on the river. This Kallai weir commands 132·30 acres of assigned wet lands, of which 47·64 acres are classed as single crop and 84·66 acres as double crop.

Storage Possibilities.—

A table showing the capacity of the proposed river at different heights of the dam is given in Appendix iii.

The storage at the 130th feet contour corresponding to a dam height of 55 feet is 379·37 M. cubic feet.

Judging from the noted increase in storage capacity for every 5 feet increase in height, a dam 70 feet high should impound about 900 millions of cubic feet. This seems to be the maximum which could be stored in the reservoir as at or near this level there are a few saddles in the boundary of the basin which will overflow. If these saddles are also dammed up with small earthern bunds to a height of 8 feet or thereabouts the height of the dam could be raised to 75 feet when a storage of about 1,110 millions of cubic feet could be effected.

With 91·41 inches of rainfall every year over a catchment of 11½ sq. miles, the total quantity of water falling in the basin is 2442 million cubic feet. Taking that about half the rainfall only is available for storage purposes, it is found that still, 1,221 millions cubic feet is available. The catchment is therefore able to replenish the reservoir even during one season.

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The Dam site.—

A cross section of the river at the site of the dam is given in plan (3). In it is also shown the approximate line of rock for foundation purposes. The location of the rock at comparatively near the surface is a very favourable point in the construction of the dam.

The cost of works.—

A tentative cross section of the proposed dam is shown in section (4).

A brief abstract of the cost is given below:—

DAM.	
12,500 units of masonry at Rs. 50 unit	Rs. 6,25,000
Valves, sluices and chambers, etc.	Rs. 30,000
Rock blasting for escapes	Rs. 10,000
MACHINERY.	
Engines, Crushers, ropes, etc.	Rs. 60,000
Roads, communication, etc.	Rs. 50,000
Contingencies	Rs. 1,00,000
Compensation for land-owners	Rs 2,50,000
Total	Rs. 11,25,000

Revenue.—

The proposal is to supply water to the Kole lands. These lands are about 20,000 acres in extent. Cultivation of this area is very difficult entailing pumping out of water during the earlier part of the operation and raising and strengthening of bunds. It is reported that the bund operations and drainage alone require on an average Rs. 30 per acre. For 20,000 acres the sum yearly spent by the ryots is then as high as 6 lakhs of rupees in round figures. Even then, the menace of drought is always present. If a supply of water is assured the Kole lands may be drained by lowering the crest of the Enamakkal weir, and great savings could be effected in conducting drainage operations. And except keeping the lake bunds from deterioration, no extensive bunding operations will be necessary. A saving of at least Rs. 20 per acre in cultivation could be effected if an external supply of irrigation is assured.

I think a cess of Rs. 6 per acre could fairly be levied. The income would be Rs. 1,20,000 a year giving a return of about 10 per cent.

Conclusion.—

On this preliminary investigation, the scheme presents to me to be one of great utility and one which is capable of solving the very long standing economic problem of the Kole cultivation.

Further the existence of a reservior of this magnitude, so near to the town of Trichur, is an aspect which is very enviable.

In this project, the detailed investigation would comprise of:—

(1) A re-survey of the site with Theodolite and levels.

(2) Close investigation of foundation conditions, taking rock dril borings.

(3) Calculations from the stream flow measurements of at least one complete season.

(4) Investigation of quarries and transport facilities.

(5) Design of dam and outlet arrangements.

If the investigation is taken up in 1103, the construction works could be started in the dry season of 1104 and completed within five years.

I strongly recommend to the Government that the detailed investigation be ordered as early as possible.

(Sd.) Chief Engineer.

(True copy)

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APPENDIX XI—(10).

Letter dated 1st July 1929, C. 27/04, from the Special Irrigation Assistant Engineer.

"With reference to your order dated January 11, 1929, C. 56/1104 and personal instructions in the matter, I have the honour to submit the following report on the preliminary survey work conducted for *diverting water from the Kurumali river* from a place called Randattumukam, where the Chekkana and the Chimni streams join together to form the main river. Just below the point of confluence the river is about 90ft. wide and the bed is sandy with laterite out-crop here and there. There will be enough water in the river during the Mundakan season, but it will be almost dry during the puncha season.

Levels were taken along the course of the river and in the lands that are likely to be benefited the datum assumed being the same as that for the preliminary survey work for the Thamarachalpadom Scheme. The bed level of the river at the place where the anicut is proposed is about plus 58·50. The spot levels of the area likely to be benefited are all given in the site plan herewith submitted.

The probable courses of the channels from the Head Works on both sides were fixed and levels taken along these courses. These are shown in the site plan in red ink. Owing to the broken nature of the country and the great depth of cutting, a considerable portion of the area especially at the first sections is not benefited. Again the channels have to be taken in a circuitous course in order to make the depth of cutting a minimum. The lengths of the channels are therefore very great.

In Appendix I (a) the cost of the north channel is worked out. Earth work including laterite cutting and rock-blasting comes to roughly Rs. 2,85,000. Cost of culverts amounts to about Rs. 15,600. An aqueduct costing about Rs. 10,000 is proposed over the Pillathodu stream. The total cost for the main channel to the north including acquisition charges comes to roughly. Rs. 3,70,600.

Appendix I(b) gives the cost of the south channel. The cost of earthwork including laterite cutting and rock-blasting is about Rs. 2,54,625 and that for culverts is Rs. 17,800. The total cost for this channel with acquisition charges comes to roughly Rs. 3,20,725.

In Appendix I, the cost of the whole scheme is worked out. A provision of Rs. 85,000 is given for Anicut, Head sluices, Scouring sluices, etc. The total cost comes to roughly Rs. 9,00,000.

Appendices 2 (b) to 2 (g) give the ayacut that may be commanded by the channel on the southern side and 2 (h) and 2 (m) by the channel on the southern side. A statement containing the consolidated ayacut is prepared and given as Appendix 2 (a). The total Virippu lands that may be cultivated with Mundakan are only about 350 acres on the north and 828 acres on the south. Total ayacut (vide Appendix 2) is about 4,325 acres. No appreciable extent of parambas can be converted into wet lands.

A reasonable water cess may be levied on the existing Mundakan lands. If an average of even Rs. 2 per acre is levied on the total ayacut as water cess, etc., the total revenue per year will be only Rs. 8,650. Even without deducting the maintenance charges from this amount, the return is only less than 1 per cent.

Of the two channels, the one on the southern side is more useful, since it commands greater ayacut than the other. Even then the scheme is not encouraging. This has therefore to be abandoned.

In the report already submitted, for the Thamarachalpadom Scheme a proposal was made to take a channel from Vasupuram. This will command

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a portion of the ayacut given in the present scheme. The figures of ayacut given therein were prepared after consulting the local village officers and they now appear to be a little high. Still that scheme will bring a better return. The detailed investigation of the diversion can be taken up after the Chalakkudi Scheme is investigated fully, as reported already".

(True copy)

APPENDIX XI-(11).

Report to accompany the estimate for opening a channel from the Muriyad Lake to Kakkathuruthi.

The scheme of opening a canal from the Muriyad Lake to Kakkathuruthi is ordered to be taken up so as to make the town of Irinjalakkuda accessible by boat traffic from Cochin. The town occupying, as it is, a central position in the Mukundapuram taluk, is the chief commercial centre whereto all the important articles of produce of the taluk, as well as the neighbouring British villages are imported. Its well known market is slowly losing its importance on account of its remote situation from the Railway Station and the Chetwaye-Mathilakam canal. The people of the locality have been petitioning the Government for the purpose of opening a navigable canal up to the town. Now that the Cochin Harbour Scheme is almost found to be a success, Government decided to have this Scheme investigated and the special party is ordered to conduct the investigation.

2. The area known as the Muriyad Lake lying to the south of the Karuvannur river and to the east of the Karupadanna road, is subjected to heavy floods during the south-west monsoons, causing damages to the Virippu cultivation of the place (see key map). To relieve this havoc, the Special Engineer for Wet Cultivation Projects proposed to open a channel from the Muriyad Lake which would cross the Karupadanna road at 11/5 and empty into the Kakkathuruthi canal, via Kattur. The channel being about 2½ miles away from the town will not be very useful as a navigable canal. It is therefore now proposed to open a canal from Thommana to Kakkathuruthi, which will pass through the fields just to the south of the present market. In addition to navigation this canal is designed also to discharge from the Muriyad Lake about 450 cusecs at M. W. L. so as to relieve to a certain extent the havoc caused by inundation in the affected area on the fringes of the Muriyad Lake. Though this will be more useful as a navigable canal, the average depth of cutting will be slightly more on this alignment than in the former.

3. In flood times as a backwash of the Muriyad Lake, water extends to the south of the Thommana road as far as the causeway near Pothambu chira. The proposed channel starts from this place with its sill at 8·00 reduced to G. T. S. datum. The M. W. L. neglecting the year's of normal floods, is noted to be plus 16·00. There will thus be 8 feet of water in the channel at the M. W. L. assumed.

4. The longitudinal section of the canal alignment is plotted and submitted. The longitudinal gradient proposed is 1 ft. per mile. The channel is 20 ft. wide at bottom with the necessary side slopes. The discharge of the channel at M. W. L. is calculated to be 450 cusecs and the calculations given as appendix.

5. The new canal taking off from the Pothambu chira runs along the existing poramboke channel in the Edakkattupadom wet lands and passes through high level parambas for short distance and then enters into the Chalampadam wet lands on the southern side of the Irinjalakkuda market (vide

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site plan). It crosses the Karupadana road at 14/1 and passes along the existing poramboke channel in Kallingapadam wet lands and then through parambas, where two drops are proposed. After the drops no bed fall is given since the canal is to be utilised for navigation purposes up to that point. The bed level after the drop is kept at 3·00, and the width is kept at 17 ft. 6 in. just after the drops and it increases to 20'-0" at the exit, so as to get the required surface fall. A boat basin 100 ft. x 100 ft. is proposed to be formed in the Paruvallipadam opposite the Peishkar road junction. After crossing the Paruvallipadam it passes through parambas in Chelur and joins the existing poramboke channel in the Kakkazha Puncha padam opposite to 2/2 of the Kakkathuruthi road. The drainage water running through the proposed canal is allowed to spread in the Punchapadam at Kakkazha. The M. W. L. at this place, excluding the years of abnormal floods, is noted to be plus 5·00. The water led into the Puncha lands flows to the south and through Avundrachal to Kettu chira and thence to the Chetwaye-Mathilakam canal. It may be mentioned here that an additional ventway will have to be provided on the Areepalam road, if it is afterwards found to be necessary.

6. In the present estimate the canal is taken only up to Kakkazha. The estimate amount for this inclusive of the land acquisition charges comes to Rs. 1,93,000. Land plans and schedule are forwarded.

7. During the recent floods the M. W. L. noted in the Kakkathuruthi and Kakkazha were plus 8·40 and plus 7·40 respectively. If there is such a difference in ordinary years also, suitable arrangements in the proposed canal will have to be made between these places to prevent the flow of water from the river to Kakkazha during floods. This portion of the canal is therefore not included in the present estimate. This may be taken up after the works now detailed in the estimate are carried out. If the level of water in Kakkathuruthi during floods is hereafter noted to be above that at Kakkazha, a suitable lock or other arrangement will have to be provided in the extension. The rough cost for the extension including all charges may come up to Rs. 35,000.

8. The possibility of connecting the proposed canal with the existing Avandarachal-Kettu chira channel ordered by the Diwan was also investigated.

If this alone is done instead of the Kakkathuruthi extension, arrangements for transhipment have to be done at Areepalam bridge and Kettu chira. If locks are provided at these places the cost will be high. Moreover the existing channel passes through low-lying lands and hence there may be the danger of salt water getting into the lands adjoining. The existing channel, may however, be improved after the works detailed above are carried out. The cost is expected to be not more than Rs. 7,500. This may then be used at the time when the ventway of Areepalam bridge and that of Kettu chira are not closed. Similarly a canal may be opened to Kattur side if found useful afterwards.

In the present estimate ¼ the cutting is taken as hard laterite ¾ as soft laterite and the remaining ¾ as ordinary hard earth. The exact proportion of these can be ascertained only during execution. The estimate will then have to be revised, if necessary. The average side slopes assumed for calculation is ½ : 1.

9. At present there are three culverts on the Pothambu chira causeway with a total span of 14 ft. A new culvert 10 ft. span is proposed on the same causeway with its sill level at plue 8·00, and a lump sum of Rs. 2,000 is provided in the estimate for the same. The estimate also provides for a bridge of 30 ft. span on the Karupadana road at a cost of Rs. 6,900. Two

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foot bridges costing Rs. 2,000 each are also given in the estimate. A sum of Rs. 2,000 is provided as supervision charges.

10. By opening this proposed canal the commercial importance of the town of Irinjalakkuda and industrial activities of the neighbouring villages will be increased considerably. There will also be some relief to the floods in the Muriyad Lake.

APPENDIX XII.

(Vide answer to question No. 333.)

Chalakkudi Inspector's report dated 11th Dhanu 1106.

Adverting to Head Office C. No. 830/1106, dated 1st Dhanu 1106, a petition from one Kanakkan C. A. Chathu and another Thupran saying among other things that they were assaulted and belaboured by some Kanakkans, Ezhuvas and Christians of Potta on the night on 11th Vrischigam 1106, while the petitioners went to the house of one Kanakkan Velandi of Potta for advising their people regarding means of progress in their community, I beg to report that the petitioners had on 18th Vrischigam 1108 produced before me a similar petition. I conducted enquiries into the matter on the receipt of the former petition itself.

I interviewed one Pullen Mathew Varkki, a teacher in the Chalakkudi High School, who, it was said by the petitioners, went to the spot when the assailants were attacking the petitioners. He said that while he was returning home from school after sports practice on the night of 11th Vrischigam 1106, he saw some people gathered in the lane near Kanakkan Velandi's house and petitioner Chathu held by his hand by Thupran. Those people were saying that he would fall in some well or other, if he was to run away rashly and senselessly. He approached them and asked Thupran what the matter was. Then Thupran told him that there was something wrong with Chathu and that he was running to and fro senselessly. He suspected if Chathan was drunk and asked Chakki, Velandi's wife, what it was. She told him that he has gone out of sense by some sorcery at the hands of his enemies. He was a respectable man, and he is a cousin of hers. She showed him a visitor's ticket granted to Chathu for admission into the Legislative Council. People who were there were for taking Chathu to Chalakkudi Police Station. But when he saw the ticket and when Chakki, Velandi's wife, told him that she could keep him safe in the night, he asked those people that they need not worry themselves about Chathu and that Chakki, his sister, would take care of him. Chakki took Chathan to her house where he remained the whole night. The next day, both Chathu and Thupran went to him to express their gratitude to him. Then he asked Chathu to be more careful and cautious in his behaviour. The teacher added that none of the people who were there, did anything to Chathu or Thupran when he was there. On the other hand, both Chakki and Thupran complained to him that Chathu in his senselessness beat them both. The people who were in the lane when he went there, were some of the neighbours. Some of them were 1. തച്ചില്ലത്ത മാണിക്കൻ, 2. പെരുകാരൻ കുട്ടൻ, 3. മാഞ്ഞാണ്ട വാര്യണ്ണി, 4. കൈതാരൻ കൊച്ചുവേലു, 5. വെളിയത്ത അയ്യു, 6. താണിപറമ്പിൽ കൊച്ചുവേലുപ്പൻ, 7. കാട്ടുപറമ്പിൽ അയ്യപ്പൻ, and some others. He could not say if any one among those referred to above had beaten Chathu before his arrival there. They were all telling that Chathu was mad or badly drunk. Chathu and Thupran told him the next day that all what had taken place the previous night was due to a fit under the influence of some evil spirit.

I questioned Chathu and Thupran in the presence of the teacher Varkki when they almost admitted the version of the teacher but offered an

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